NPP Sounder Progress: CrIS & SDR Status

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NASA Sounder Science Team Meeting

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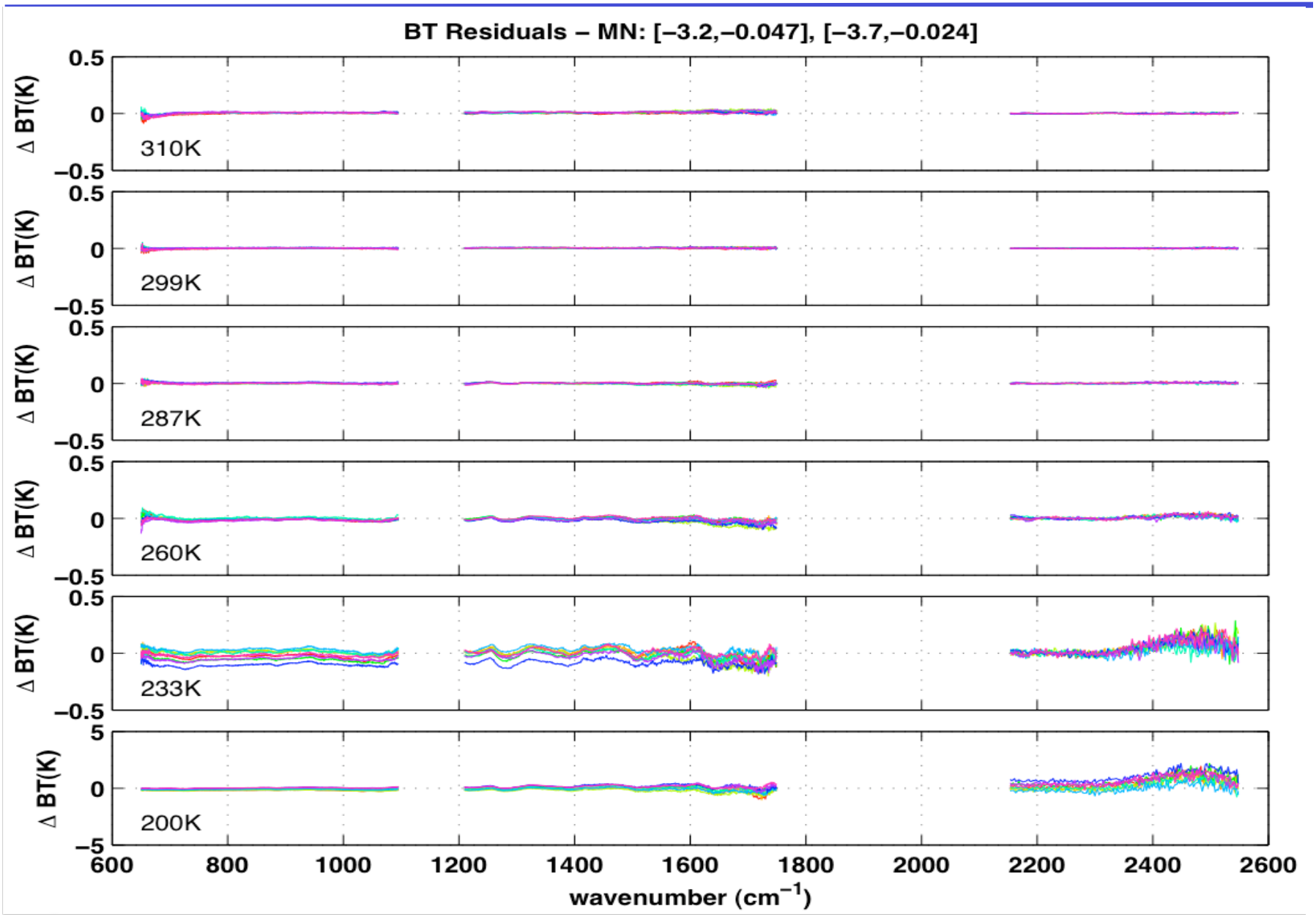
You may be tempted to ask, "Just where are we now?"

CrIS & SDR Progress Summary

- **CrIS instrument MAY have completed TV phase.**
  - **Careful analysis and fixing of CCB problems continues**
    - > **Detailed analysis has significantly reduced RU**
    - > **Instrument mostly passes specification as is – but QC may require additional functional testing before PSR**
    - > **If a fourth T/V is executed, there some additional calibration requested**
    - > **Government team continues close work with ITT, NGC on test data analysis.**
  - **Request for quote on cost of initial survey to determine if CrIS can collect full (0.5 cm^{-1}) data from all three bands will be issued to NGC.**
- **GRAVITE Development**
  - **FY10 effort to concentrate on tool and procedure development, testing**
- **Cal/Val plan submitted to IRB with good results**
- **Aircraft Error Analysis completed – briefed to IPO/NASA**
  - **Funding and schedule plan working thru the IPO**
- **CrIS/ATMS GRAVITE development continues**
  - **Conversion and testing is now being coordinated with Direct Readout team.**

UW Assessment of CrIS Performance



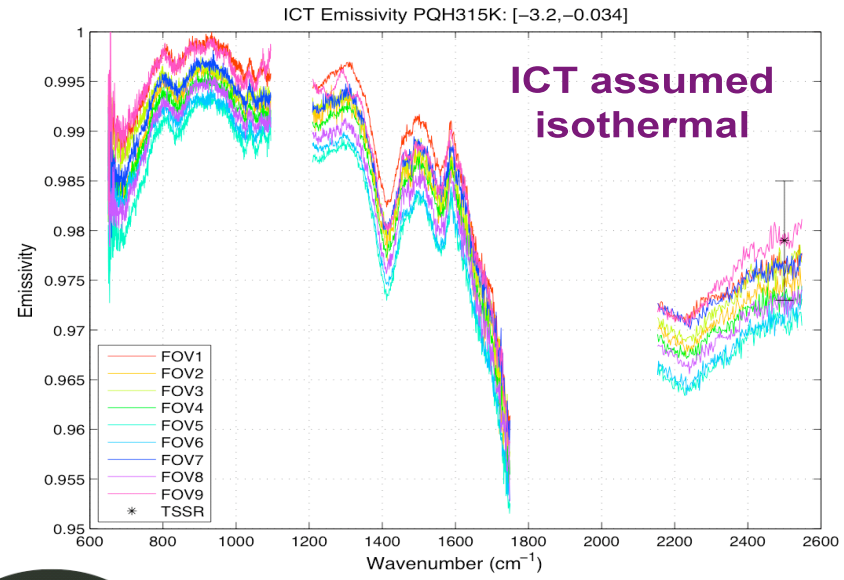
ICT Performance Analysis Continues

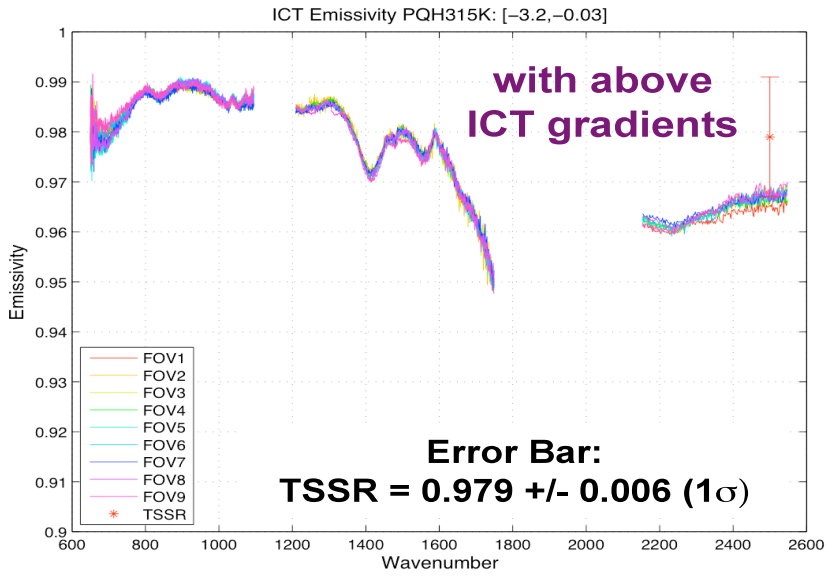
Emissivity Derivation Implications

1. **Radial ICT Temperature Gradients for 315 K test** (Corners, Sides, Center)

FOV	1	2	3	4	5	6	7	8	9
ICT Gradients	0.029	0.016	0.020	0.012	0	0.004	0.021	0.008	0.027

2. **FOV-independent emissivity, implying no strong specularity**





Supports validity of diffuse reflectance background model

ILS Algorithm Correction

SDR algorithm performance: ILS correction
TECT= 287 K MN Side2

ILS Corrections **OFF**

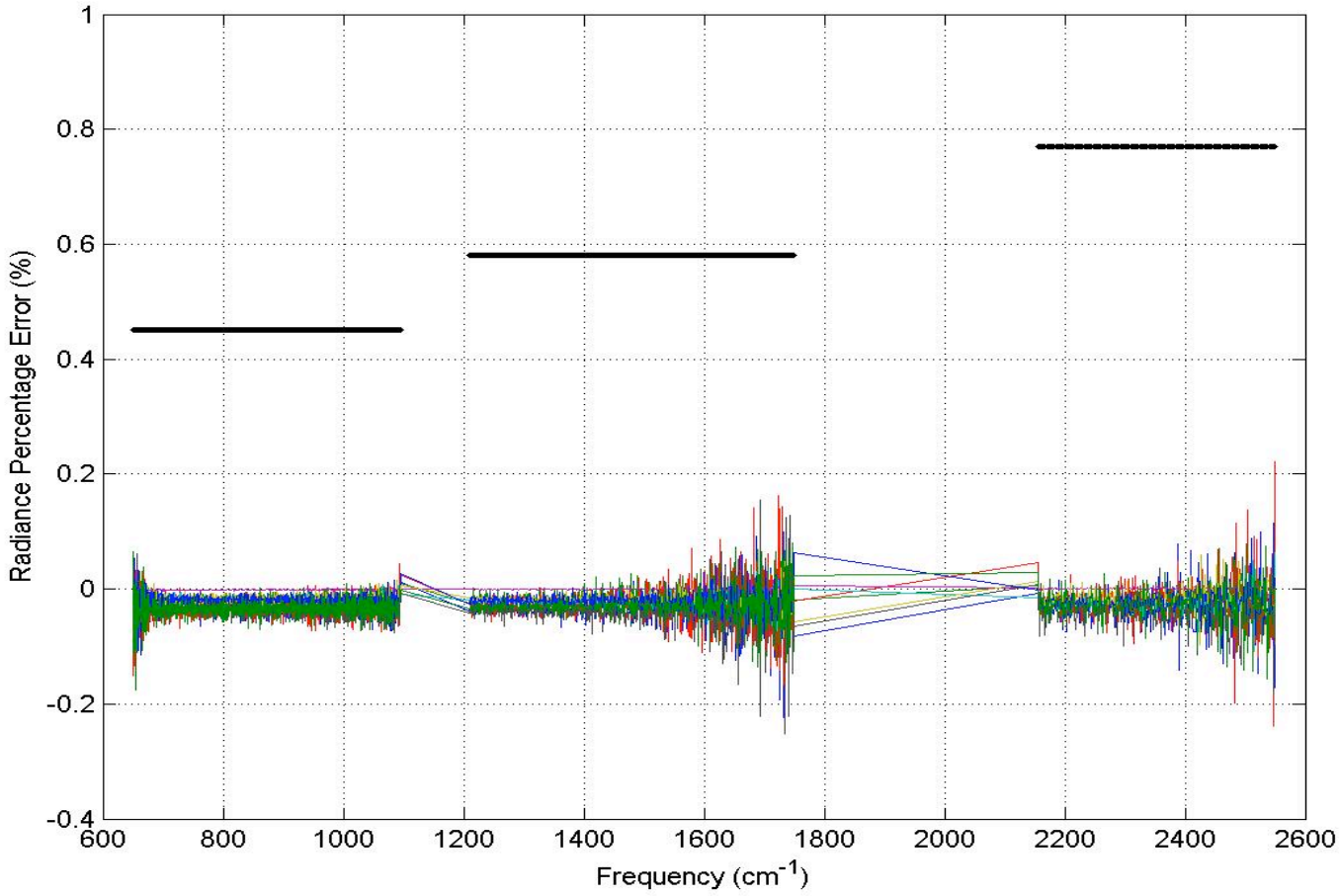
ILS Corrections **ON**

Reduced to a few mK offset by a NGC modification to V2.18 submitted to IDPS last month

ILS correction induces additional radiance error of 20-80mK

Improved Radiometric Calibration

- **Small offset suspected due to SA correction matrix not properly normalized – causing a very small (~0.04%) bias**



Cal/Val Plan Progress

- **Release of plans to public planned for Oct. 2009**
  - **All the EDR plans in IPO public release process.**
  - **SDR plans have some proprietary and ITAR issues.**
  - **New update to CrIS plan submitted by Denise in October.**
- **Refine algorithm change process to detail process during EOC and ICV**
- **Working interagency "handshakes" necessary to assure availability of collaborative data and data analysis resources.**
- **Investigating the utility of customer workshops prior to or immediately post-launch.**
- **IPO is working with C/V leads to develop implementation plans detailing schedule and deliverables of tasks within each team.**
  - **NGC and other members often show different schedules**
  - **Specific effort to coordinate schedules with NPP Mission Team**
- **Long term budget planning process in action!**
  - **Goal to develop budgets thru 2015.**

NPOESS Cal/Val IRT: Structure & Purpose

- **Cal/Val IRT directed by NESDIS to ensure NPOESS Cal/ Val Program Success**
  - **Panel Membership**
    - > **Dr Paul Menzel (U Wisc) (Chair)**
    - > **Dr Paul Try (STC)**
    - > **Dr Peter Kealy (Deltica (U.K.))**
    - > **Dr Tom VonderHaar (Colorado State)**
    - > **Dr Jon Ranson (NASA GSFC)**
    - > **Supplemented by Letter Reviews**
- **Panel read 19 documents& provided detailed questions**
- **Results briefed at NOAA PMC 20 Aug.**
  - **Report satisfied "hand wringing" over cal/val at NESDIS and the PMC.**
- **IPO Response briefed at NOAA PMC**
  - **2 Main Issues:**
    - > **System-level view of cal/val program needed**
    - > **Resources need to be balanced across teams**

Specific Comments/Recommendations
CrIS SDR (1/2)

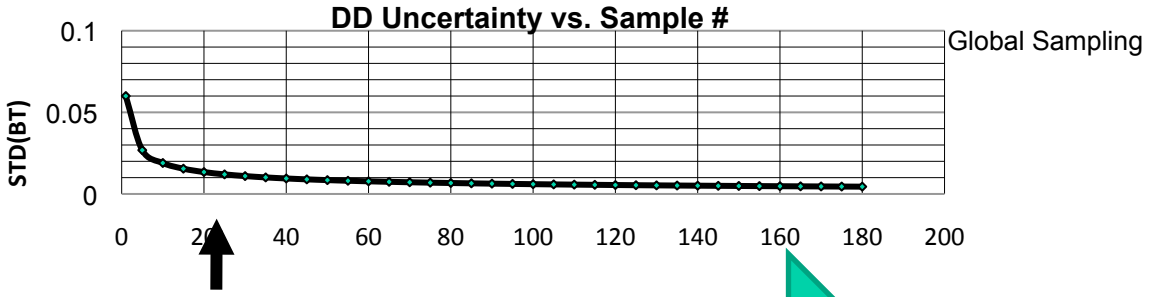
- CrIS SDR CVP is well-written and complete.
- CrIS Cal/Val relies on aircraft underflights; valuable examples of lessons learned and long term monitoring completed with aircraft underflights of the AIRS instrument on Aqua were presented.
- It was emphasized that currently the only possible direct connection to NIST is through aircraft underflight missions. Calibration to milli-Kelvins has been accomplished in JAIVEX; this is the goal for climate worthy data sets (e.g. CO2 concentrations).
- An early post-launch aircraft campaign separates instrument from algorithm issues, establishes the trustworthiness of team communications and software compatibility, and assures early assimilation of the measurements.

Specific Comments/Recommendations
CrIS SDR (2/2)

- But there is also benefit to using rapidly emerging techniques for SDR assessment and monitoring by (a) Satellite-to-Satellite radiance Match-Ups (aka Simultaneous Nadir Observations (SNOs) which could be realized between EOS and NPP and C1 in very similar orbits at 1330 LT ascending nodes) and (b) Global Modeling and Assimilation Systems to check and detect out-of-family SDRs. Consideration of these was incomplete (see 2.4).

- A strong pre-launch characterization of CrIS has given confidence that issues identified (non-blackbody emissivity of the Internal Calibration Target, line shape correction, and others) have been overcome.

Satellite Sensor Inter-comparison Uncertainty



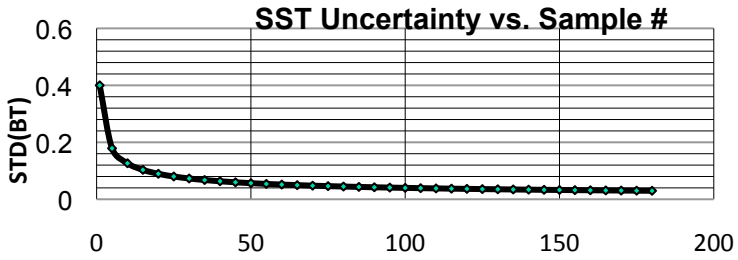
SNO => ~ 100mK
SST => ~ 30 – 60 mK
DC => ~90 – 120 mK
DD => ~ 5 - 60 mK

1σ values

SNO & Double Difference

CrIS Uncertainty

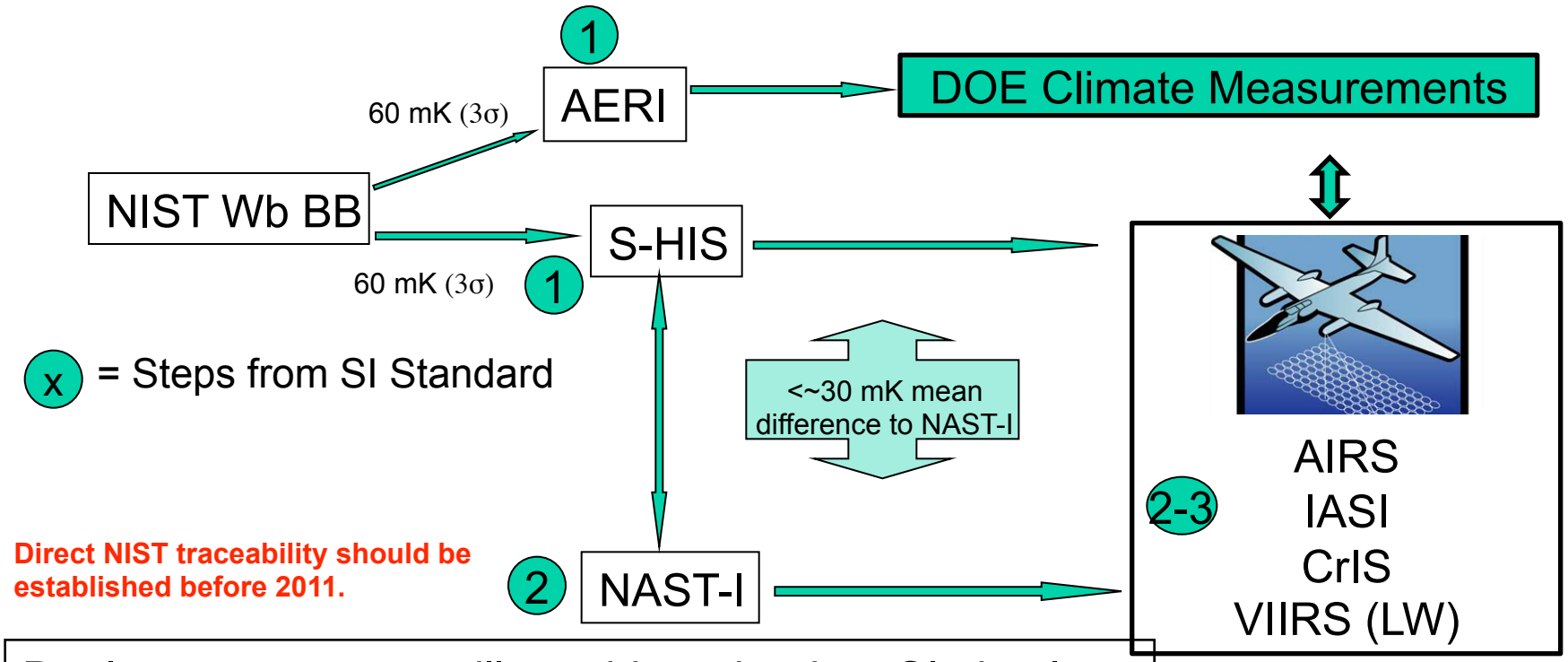
Time ⟶ ??



Previous Aircraft Measurements

- AIRS & IASI ground calibrations were carried to orbit and have provided relevant inter-satellite comparisons.
- Our absolute accuracy acceptance is partly based on aircraft underflights.
- **Different methods show a range of uncertainty results, leaving actual values uncertain.**

Aircraft Radiometric Uncertainty Chain



Dual measurements will provide redundant SI absolute traceability to less than 60 mK (3σ)

$RU_{CrIS} = (RU_{S\text{-}HIS} + RU_{NAST\text{-}I})/2 < 30mK$ (mean)*

Uncertainty reduced by ~2 to ~ 30mK

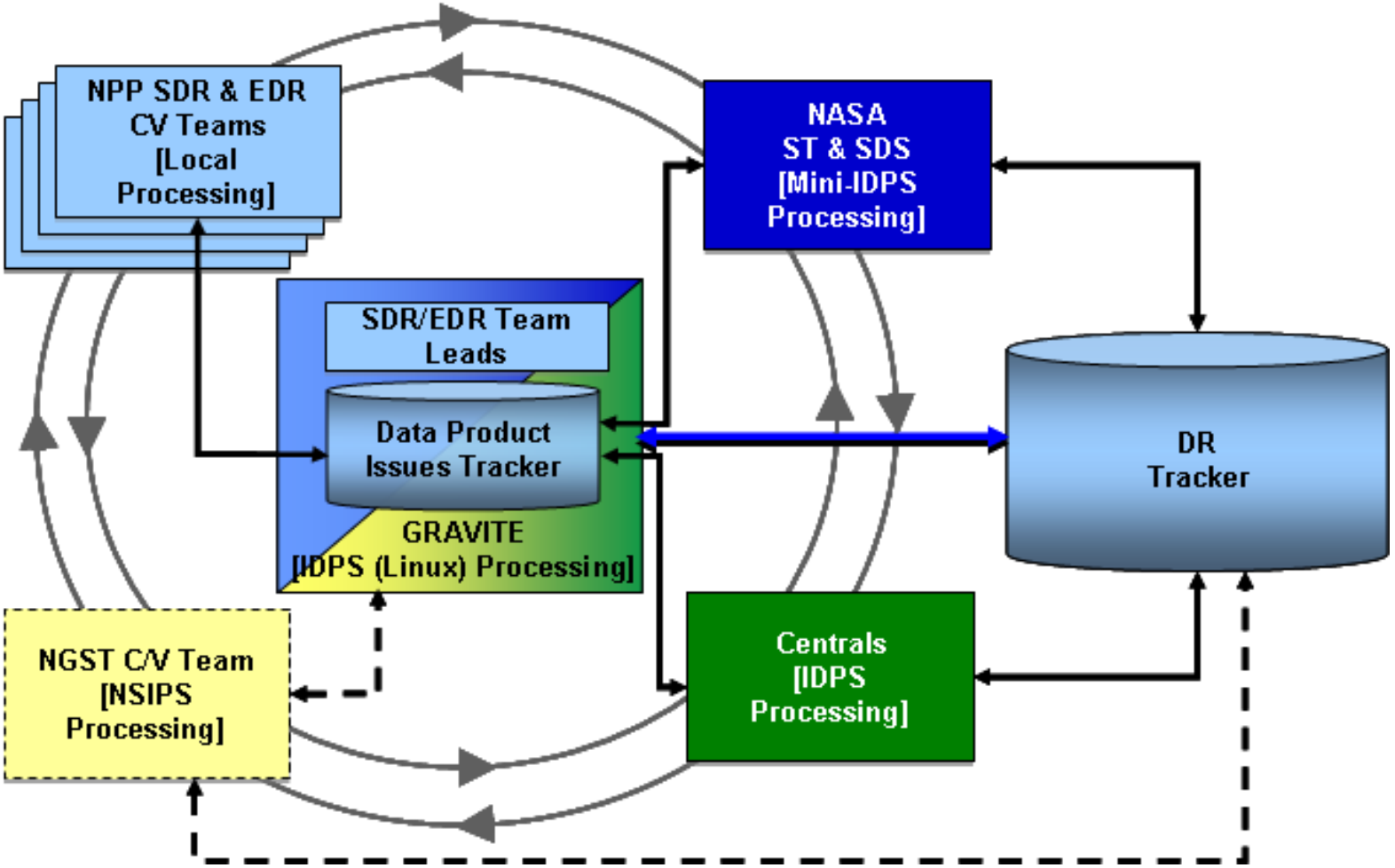
Two sensors provide verification, reduce uncertainty

*ignores sampling error

IRB Concerns

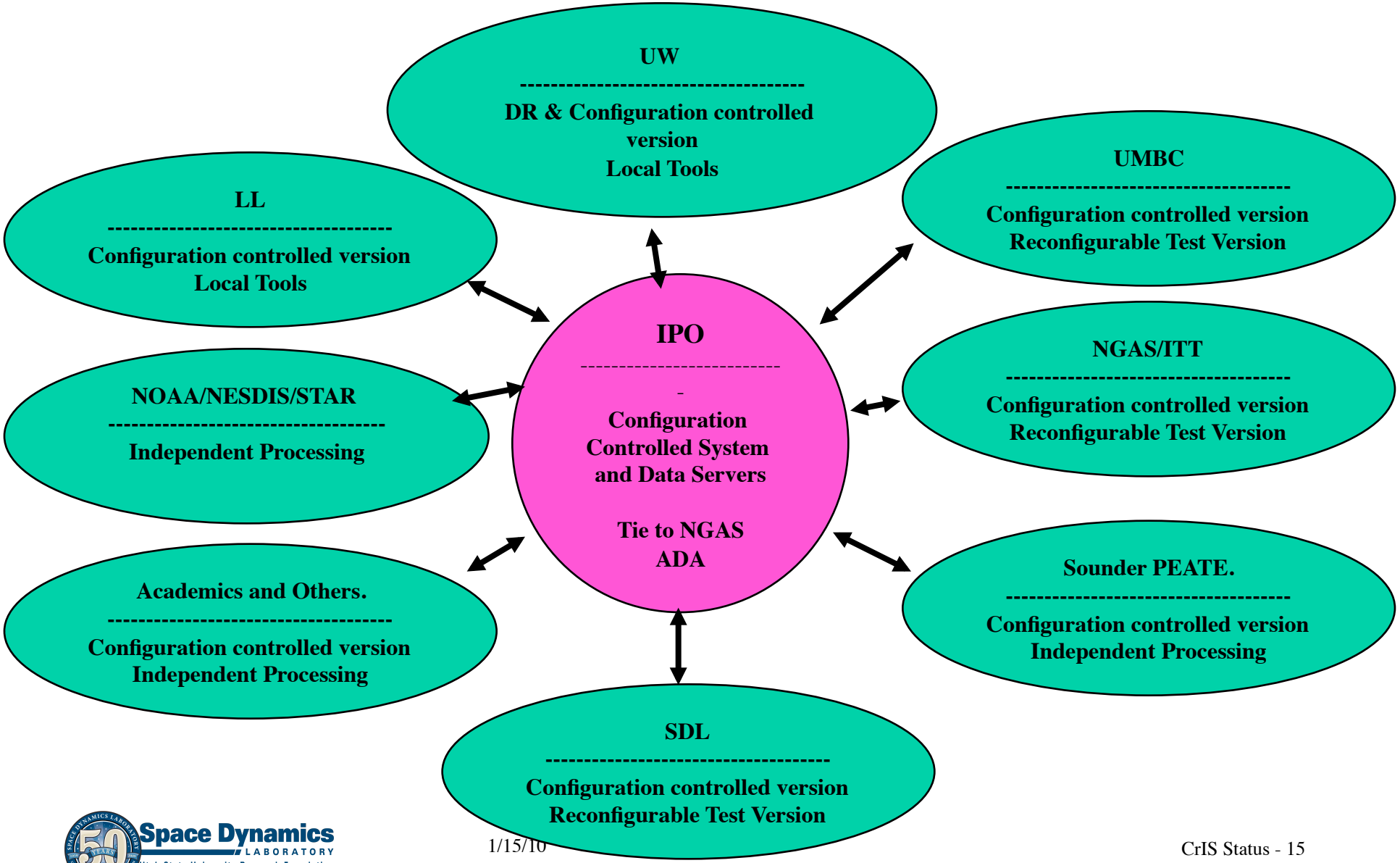
- ***Algorithm Change Process***
  - The very necessary and detailed process to consider and implement algorithm changes has the potential to bog down the development and effectiveness of the Cal/Val process. The establishment of short suspense dates for each element of the process, and fast track pathways for necessary, but more minor changes, should be well defined and emphasized. It is recommended that the change process be exercised significantly prior to launch.
- ***Aircraft under-flight campaigns planned well in advance***
  - Planning and resourcing of aircraft under-flight campaigns should begin as soon as possible for several of the SDR/EDR efforts. The relative role of aircraft under-flights versus SNOs for transfer of calibration and for validation warrants more study, as well as the benefit per resources expended in an AIRS-like aircraft campaign for NPOESS.
- ***Partner agreements should be solidified***
  - The IRT recommends moving ahead with more formal planning with other agencies and international groups via MOUs/MOAs/handshakes to solidify parts of the CVPs that may need and benefit from the assistance of others.
- ***Workshops for community familiarization***
  - While not specifically a Cal/Val issue, with the GRAVITE asset, the IRT recommends holding Data Workshops with simulated/proxy data for the NPOESS SDRs/EDRs to provide the user community better insight to the expanded benefits coming with the new NPOESS data sets.

Cal/Val Communications/Coordination

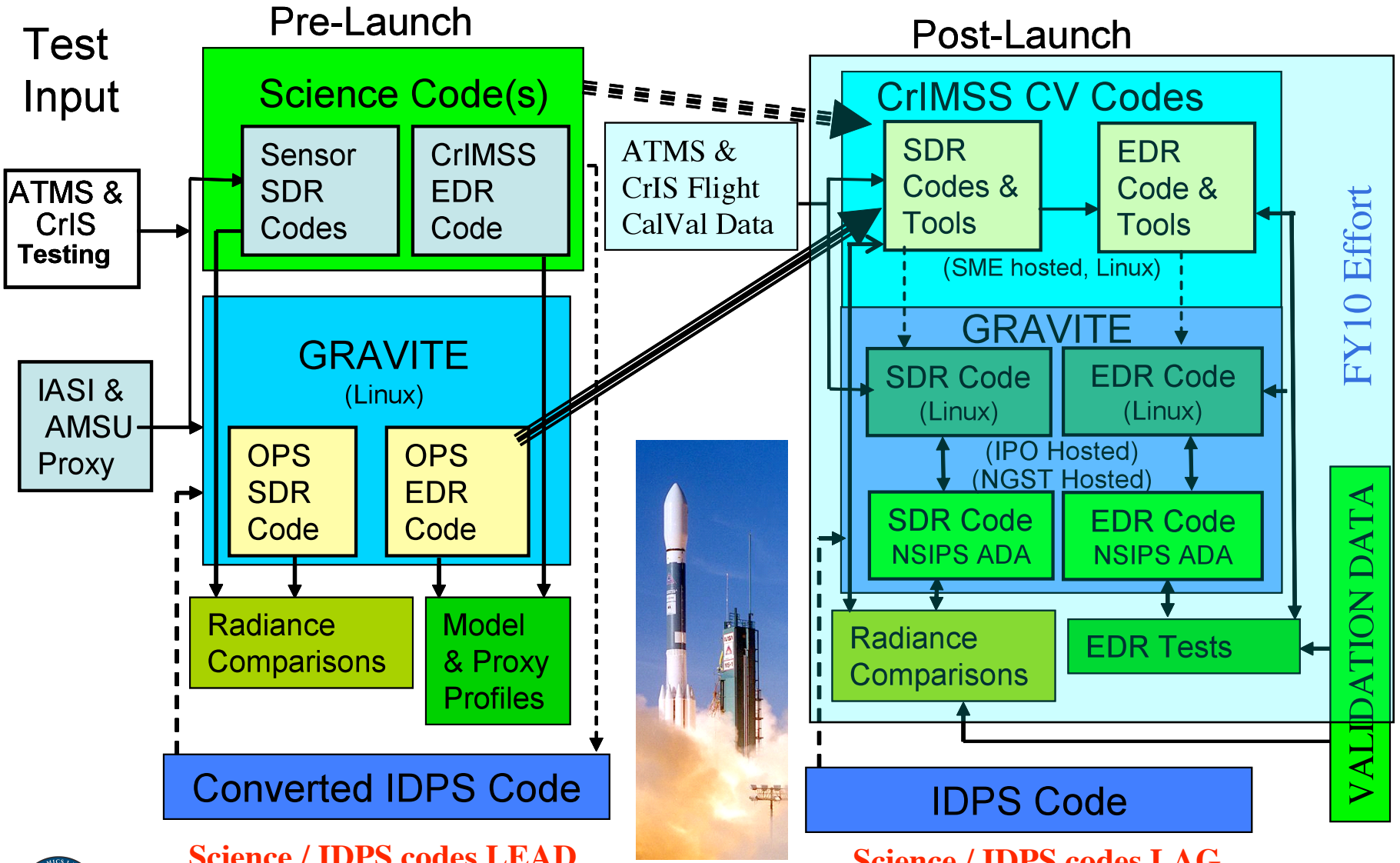


Team members linked by internet and teleconferencing links

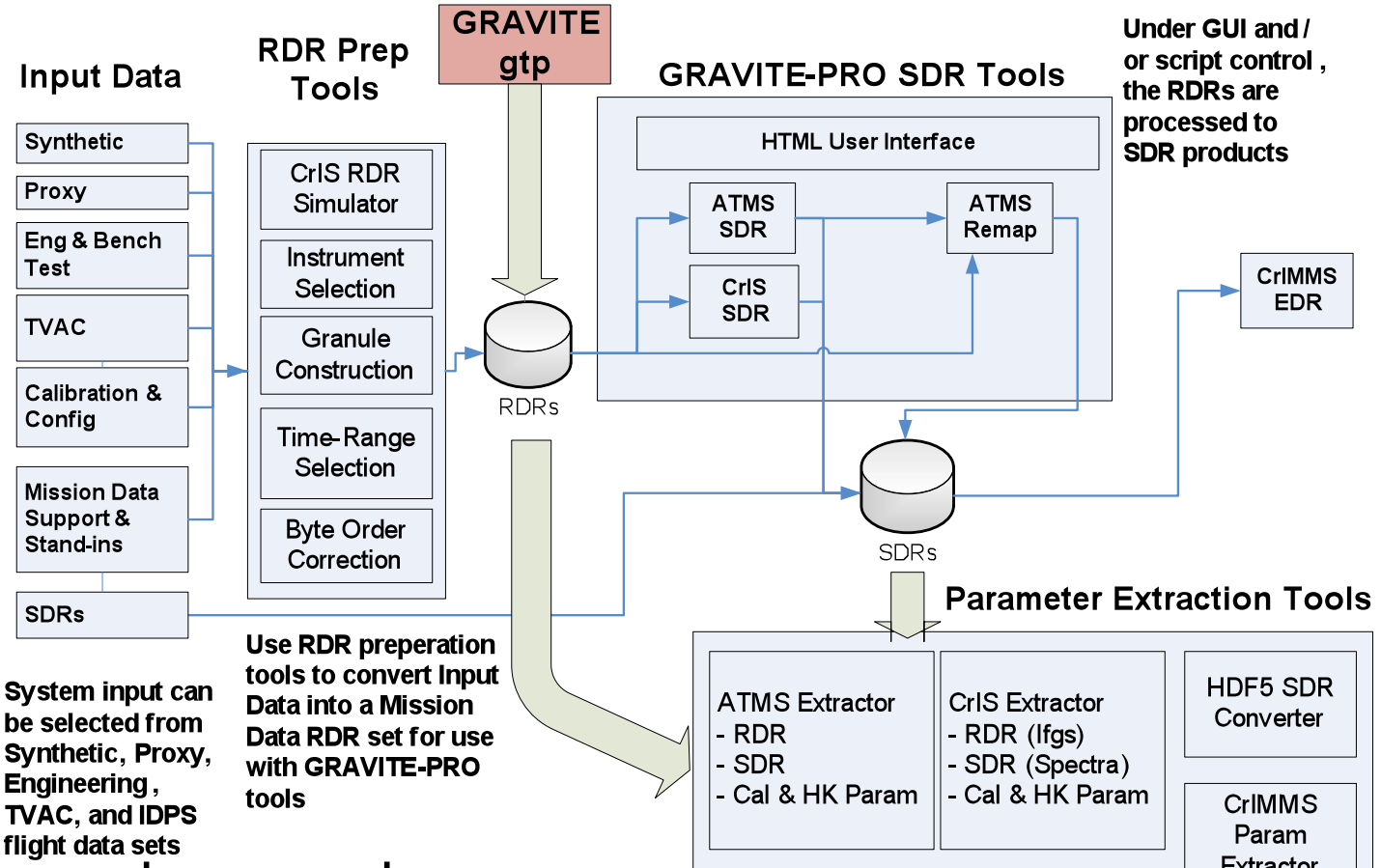
Distributed Processing Concept



Cal/Val Data Processing Support



CrIS/ATMS GRAVITY SYSTEM OVERVIEW



First hands on demo and training held at SDL on 9/12 for SOAT attendees.

Status Summary

- We have held a meeting with UW to determine common modes of collaboration that exist between our work on the CrIMSS GRAVITE port and the port that UW is performing for Direct Readout infrastructure. We identified a number of data sets and code updates that we were both working with and have exchanged both data sets and code updates. It has been a profitable experience for both sides.
- We have been working with Xiu Lu (LaRC) and Degui (NGAS) on the platinum day data set for CrIS. We are very close to having baseline versions of synthetic, proxy, and TVAC data that are well documented and tested for community use against CrIS SDR performance efforts.
- We have finished the baseline CrIS GRAVITE port and we are now close to completing the ATMS GRAVITE port.
- We are visiting NGAS monthly as a Cal/Val tagup for issues and tests.
- We will visit the IPO on 10/30 for a "work day" to integrate of the CrIMSS GRAVITE port and associated user interface tools.
- We have all of the hardware fabricated and the TVAC test plan approved by ITT for the NIST validation efforts of ECT at ITT.